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Mapping In Situ Optical Properties in Coastal Waters Using Slocum Gliders During RIMPAC

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LONG-TERM GOALS

Characterizing *in situ* water turbidity is critical to numerous naval operations. In particular, water column turbidity impacts the efficacy of sensors that use optical measurements for a variety of purposes including laser detection of mines and prediction of the operational detection horizon for bioluminescence. To this end we have been developing an autonomous platform outfitted with this sensor package and reporting the data in near-real time prior to and during advance into a battle space. The endurance, water column coverage, stealth, and mobility of the Slocum Coastal Glider provides an ideal platform when coupled with the correct optical suite to accomplish this utility. Our long term goals is to develop and demonstrate the ability of Webb gliders to map the *in situ* optical proerties. For this effort working with NAVOOCEANO and Metron, we delievered data which was ported to classified mission planning tools.

OBJECTIVES

During the MIREM 2004 and 2005 efforts we in collaboration with WetLabs and Metron have demonstrated that the Webb gliders are capable of carrying the optical sensors appropriate for mapping the incident optical conditions in mesotrophic coastal waters. Building on these accomplishments, our goal in 2006 was to demonstrate the capability of Webb gliders to characterize the optical properties in oligotrophic waters within the nearshore operational zone of the 2006 RIMPAC field effort. In June and July of 2006 an exercise was conducted with the AQS-24 Laser Line Scan (LLS) system during the RIMPAC operation offshore Hawaii. Our goal was in support of this effort was to map the in-water optical properties to assess the potential, performance of the AQS-24 system. Specifically for the LLS, the performance issues to be focused on include the reacquisition and identification probabilities in a diverse range of coastal waters. Building off these efforts we during the 2008 RIMPAC effort flew three gliders and supported Glider operations of the NAVOOCEANO gliders.

APPROACH

The research in the recent year consisted of the following tasks:

Task 1. We used optically outfitted Gliders to map in the in-water physics and optics during the 2008 RIMPAC efforts. With ONR support a bio-optical glider has been developed. In collaboration with Michael Twardowski (WetLabs Inc.) and Clayton Jones (Webb Research Inc.), we have integrated the AUVB scattering sensor. These scattering sensors will be complemented with WetLabs pucks, which will provide the measurements of spectral backscatter. The pucks will also provide measurements of the fluorescence of Chlorophyll a (Chl a) and Colored Dissolved Organic Matter (CDOM) fluorescence. Finally the apparent optical measurements will be made with an upward OCR Satlantic multi-spectral radiometer. These measurements will provide a detailed picture of the in-water optics measurements. The gliders will be deployed one month prior to the ship cruise and provide near real-time data back support shore side planning prior to the cruise.

Task 2: Assist NAVOCEANO during the RIMPAC 2008 effort. We supported NAVO personnel in the field during the RIMPAC. The data was piped directly from the Glider to the NAVO office at Stennis Center. The data and communication transmission allowed direct NAVO control of both Navy and Rutgers Gliders throughout the field effort. These data were fed directly into the Metron system performance models to allow for mission planning.

WORK COMPLETED

Rutgers Gliders were present in the water two weeks prior and throughout the RIMPAC experiment. Glider control was maintained by NAVO personel which maintained a secure firewall which precluded any Rutgers people from seeing and utlizing the data. Despite this Rutgers scientists supported NAVO to maintain shore communication at Stennis Space Center. Shore side support in Hawaii was also provided by Rutgers personnel in the field throughout the deployment. These personel actively supported both the Rutgers and NAVO gliders.

RESULTS

Data was successfully gathered by the Gliders and the data improved the mission planning. While there were no data driven discoveries with this deployment and significant lessons learned.

1) Current Glider training is one week long. We believe that training should be longer than one week. The extended training should focus on trouble shooting and diagnosisng problems that will be encountered in the field.
2) NAVO personnel would benefit from a resource library to assist interpretation of optical data in order to determine when the data is not reasonable.
3) Gliders should be outfitted with onboard QA/QC algorithms. This automated preprocossing could allow unreasonable data to be screened onboard or shore side. This is critical as increasingly Mission planning tools are being automated and it will be critical to filter data as personel often do not conduct visual QA/QC.

IMPACT/APPLICATIONS

The Navy's mission has transitioned from a deep blue water tactical theatre to a littoral environment; however present Naval operational capabilities do not have the required data fidelity to deal with the complexity of coastal waters. These shortcomings are compounded as traditional sampling approaches are quickly compromised in denied access regions. The development of a long duration covert capability for collecting environmental (hydrographic and optical) data will offer a new paradigm in solving this problem. Using mine counter measures as an example, optical data would feed back on submersed and aircraft laser line scan mission planning by impacting the effective depth at which the laser can "see". If the environmental characterization is performed over relevant scales the applications will assist real world missions, including mine detection and mine-counter measures, Special Forces operations, amphibious landings, shallow water anti-submarine warfare and force protection from terrorism

RELATED PROJECTS

The data is being freely shared with Metron, Anteon, Surface Warfare Development and NAVOCEANO. Developing the optical capability for gliders will directly benefit a recently funded Major University Research Initiative (MURI), which will develop a data assimilative physical-optical modeling-observation system consisting of an ensemble of optical models of varying complexity. This MURI will study the regulation of ocean color for a broad western boundary continental shelf with a specific focus on regions of high optical variability (fronts), which coincides with regions of high acoustic uncertainty.

REFERENCES

none

PUBLICATIONS

This one year effort has not resulted in any publications.